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Issues to be improved on the Thermal Performance Standards for Sustainable Buildings consolidation: an overview of Brazil

Raquel Diniz Oliveira[a,b,c], Roberta Vieira Gonçalves de Souza[b], Roberto M. da Silva[c]*

[a]*Department of Civil Engineering, Federal Technological Education Center of Minas Gerais, Av. Amazonas, 7675, BH - MG, 30510-000, Brazil*
[b]*Laboratory of Environmental Comfort, Federal University of Minas Gerais, Rua Paraíba, 697, Belo Horizonte - MG, 30130140,Brazil*
[c]*Department of Structural Engineering. Federal University of Minas Gerais, Av. Antônio Carlos, 6627, BI, 4° pav.,BH - MG, 31270-901, Brazil*

Abstract

The Residential buildings have a great importance on the increased demand for electrical energy that grows with population increase and urban development, especially in countries such as Brazil with a growing population. In this case, the requirements addressed in the building standards are relevant to ensure the suitability of the envelope thermal performance and, consequently, upgrade the building energy performance. The Brazilian standards in thermal and building energy efficiency are relatively new and their application still points out to the necessity of improvements. Therefore, this paper analyzed those building thermal performance requirements according their prescriptive and simulation methods. The present study aims to explicit the differences between these two methods and also addresses the efficacy of the standard requirements to consolidate a better residential building thermal and energy performance in Brazil. As a result, some improvement considerations are proposed for those standards.

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Keywords: Sustainable buildings; Thermal Performance requirements; Brazilian standards.

1. Introduction

The world demand for energy has increased over the past decades, due in a great part to the growth of world population. According to the International Energy Agency (IEA), between 2010 and 2050 the projected demand will double, in a business-as-usual scenario. In Brazil, urbanization advances and the growth on the number of houses fostered the demand for energy consumption. In the six degree scenario of rise in global average temperatures, the

* Corresponding author. Tel.: +55 31 99679-1240.
E-mail address: raqueldo@gmail.com

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Brazilian electrical energy consumption can increase by 65% between 2010 and 2050, especially because the rise in electrical appliance and space cooling equipment [1].

According to British Petroleum (BP) statistics, "in 2014, Brazil was the eighth-largest energy consumer in the world and the third-largest in the Americas, behind the United States and Canada" [2]. Since 2015, Brazil has undergone a critical crisis of water and hydroelectric energy supply. Climate changes raised the summer temperature and substantially reduced the rain period, exceeding the worst reference rate since 1953. Thus, the energy consumption for artificial cooling increased, causing, at peak moments, interruptions of the power supply in several big cities [3]. The consequence was an expressive increase on electricity costs which, currently, have three tariffs, ranging from the cheaper to the most expensive, according to the conditions of the power plant generation, that is, when thermoelectric plants have to operate in full power due to a larger demand than hydroelectric plants can provide [4].

The Brazilian Energy Balance (BEN) indicated that, in 2014 the houses were among the largest consumers of electricity, with 24.9% of representativeness, surpassed only by the industries, with 38.8% [5]. In this context, the energy savings for residential consumption is relevant and as houses are mostly naturally conditioned, their thermal behavior is of great importance in this scenario.

In Brazil, two standards address the thermal behavior of a residential building: NBR 15,220 (2005) [6] and NBR 15,575 (published on 2008, revised and mandatory from 2013) [7]. The first one establishes in part 3, eight Brazilian Bioclimatic Zones (BZ) as it can be seen in Figure 1, and sets seasonal strategies and specific constructive guidelines for each bioclimatic zone in order to optimize houses thermal performance. The fundamental concepts of this standard are based on Givoni's bioclimatic chart (1992) and in Mahoney's spreadsheets (1970). The other one, NBR 15,575 establishes performance standards for new housing in thermal, acoustic, luminous and structural aspects, along with fire safety and durability. Performance criteria are set for Minimum, Intermediate or Superior compliance. The building must comply with specific limits for thermal transmittance (U), thermal capacity (TC), solar radiation absorptance (α), as well as minimum areas for ventilation and daylighting for the BZ in which it is located. If the building does not achieve the expected limits, it must be reevaluated according to an established computer simulation method.

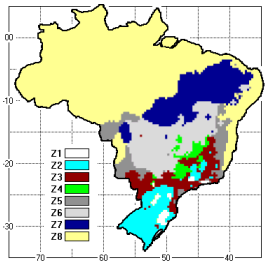

Fig. 1. Map of Brazilian Bioclimatic Zones. Source: NBR15.220-3 [7].

There are also other regulations and certifications in Brazil to evaluate the residential building thermal and energy performance such as the Blue House Label (published in 2010 and revised on 2014) [8] and the Technical Quality Regulation for the Energy Efficiency Level of Residential Buildings (RTQ-R, published in 2010 and revised in 2012) [9], both voluntary procedures nowadays. As described by the National Energy Efficiency Plan (PNEF) mandatory evaluation by the RTQ-R should take place in 2031 [10]. The Blue House Label certifies the sustainable character of social housing or submitted to the funding programs of the Federal Savings Bank, CAIXA. According to this label, the project is evaluated using six general parameters: urban quality, design and comfort, energy efficiency, material resources conservation, water management and social practices. The parameters for the thermal performance of walls and roofs were based on NBR 15,575 (2008), NBR 15,220 (2005). The adhesion process is voluntary and the certification has three categories: Bronze, Silver and Gold whereas for minimal grading, the building must satisfy at least the mandatory criteria. For the intermediate level, it must comply with six extra criteria of free choice and for the Gold category it must comply with twelve extra criteria of free choice.

The RTQ-R specifies the technical requirements and methods for the classification of residential buildings according to their energy efficiency level ranging from A (better) to E (worse). There are three types of labels: one for housing units, one for multi-family buildings as a whole and one for their common use areas. For the housing unit, the